9. The rectifier device of claim **1**, wherein the structure between the vertical midpoints of each of said trenches comprise a rectifier cell, further comprising a plurality of additional trenches recessed in said drift region and spaced periodically within a given area with said first pair of trenches, each of said additional trenches having oxide side-walls, a shallow P^+ region at its bottom, and a conductive material for conducting current from the top of the trench to its shallow P^+ region, the conductive material and side-walls in each of said additional trenches contacting said second layer of metal, each of said additional trenches forming an additional one of said rectifier cells, said additional rectifier cells increasing the current carrying capacity of said rectifier device when said device is forward-biased.

10. A rectifier device, comprising:

an P^+ layer,

a first layer of metal on said P^+ layer providing a first connection point for said device,

an P^- drift layer on said P^+ layer,

a pair of trenches recessed vertically into said P^- layer opposite said P^+ layer, said trenches separated by a mesa region,

a layer of oxide lining the sides of each of said trenches to form oxide side-walls in each of said trenches,

a respective shallow N^+ region in said P^- drift layer at the bottom of each of said trenches which extends around the corners at the bottoms of said sidewalls to protect said corners from high peak electric fields when said device is reverse-biased, the separation between said shallow N^+ regions being less than the ambipolar diffusion length of the device,

a conductive material in each of said trenches for conducting current from the top of each trench to its respective shallow N^+ region, said conductive material comprising polysilicon which has been heavily-doped with donors, and

a second layer of metal contacting said mesa region, said conductive material, and said oxide side-walls, said second layer of metal forming a Schottky contact at its interface with said mesa region, said second layer of metal providing a second connection point for said device,

said P^+ layer, said P^- drift layer, said first and second layers of metal, said first pair of trenches, said layer of oxide, said respective shallow N^+ regions, and said conductive material arranged such that a voltage applied across said connection points which forward-biases the device produces conductivity modulation in said drift region allowing current to flow from said first to said second connection point via said Schottky contact and said shallow N^+ regions, and a voltage applied across said connection points which reverse-biases the device produces depletion regions in said mesa region alongside said side-walls and around said N^+ regions which provide a potential barrier that shields said Schottky contact from a high electrical field and thereby reduces reverse leakage current.

11. A high power rectifier device, comprising:

an N^+ layer,

a first layer of metal on said N^+ layer providing a first connection point for said device,

an N^- drift layer on said N^+ layer,

a plurality of trenches recessed vertically into and spaced periodically through said drift layer opposite said N^+ layer, every pair of said trenches separated by a respective mesa region,

a layer of oxide lining the sides of each of said trenches to form oxide side-walls in each of said trenches,

a respective shallow P^+ region in said N^- drift layer at the bottom of each of said trenches which extends around the corners at the bottoms of said sidewalls to protect said corners from high peak electric fields when said device is reverse-biased, the separation between said shallow P^+ regions being less than the ambipolar diffusion length of the device,

a conductive material in each of said trenches for conducting current from the top of each trench to its respective shallow P^+ region, said conductive material comprising polysilicon which has been heavily-doped with acceptors, and

a second layer of metal contacting each of said mesa regions, and the side-walls and the conductive material in each of said trenches, said second layer of metal forming Schottky contacts where it contacts said mesa regions, said second layer of metal providing a second connection point for said device,

said N^+ layer, said N^- drift layer, said first and second layers of metal, said plurality of trenches, said layer of oxide, said respective shallow P^+ regions, and said conductive material arranged such that a voltage applied across said connection points which forward-biases the device produces conductivity modulation in said drift region allowing current to flow from said second to said first connection point via said Schottky contacts and said shallow P^+ regions, and a voltage applied across said connection points which reverse-biases the device produces depletion regions in said mesa regions alongside said side-walls and around said P^+ regions which provide a potential barrier that shields said Schottky contacts from a high electrical field and thereby reduce reverse leakage current.

12. The high power rectifier device of claim **11**, wherein said device resides on a die in which said drift layer, said N^+ layer and said first and said second metal layers run the length and width of said die.

13. The high power rectifier device of claim **12**, wherein each of said trenches is a channel which runs the length of said die and said trenches are spaced periodically across the width of said die.

14. The high power rectifier device of claim **12**, wherein each of said trenches is approximately cylindrical about a vertical axis, said trenches spaced periodically within said die.

15. The high power rectifier device of claim **12**, wherein said N^+ layer is a bulk substrate material and said N^- drift layer is an epitaxial layer grown to a desired thickness on said N^+ layer.

16. The high power rectifier device of claim **12**, wherein said N^- layer is a bulk substrate material and said N^+ layer is implanted into the backside of said N^- layer and has a thickness of less than about 0.5 μm.

17. The high power rectifier device of claim **11**, wherein the thickness of said drift layer is sufficient to provide a reverse blocking voltage for said device of at least 1200 volts.

18. The high power device of claim **11**, wherein the surface area of said die is about 0.5 cm^2 and said rectifier device can accommodate a current of at least 50 A when forward-biased.

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